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AUTHOR Hartman, E. Alan; And Others
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ABSTRACT

Any attempt to describe every job position and the activities contained in it would yield a confusing mass of information. Consequently, industrial psychologists have generated methods for classifying occupational positions into a smaller number of jobs or job families. Based on prior research it has been concluded that different kinds of job descriptors yield different job classifications. The limited robustness of such classification systems observed in previous efforts might be attributed to the use of only a few, relatively homogeneous jobs. To examine this hypothesis, both task and ability requirements data were used to describe some 600 positions in occupational fields ranging from clerk to computer programmer. All student assistant positions within a midwest university were studied. A job analysis questionnaire was developed and 79 supervisors of student assistants were asked to complete one response sheet for each unique student position supervised. Separate occupational classifications were developed for each type of indicator using a Ward and Hook (1963) procedure. In cross-validation, it was found that the two indicator types yielded very similar occupational classifications. These findings support the validity of job families derived from the Ward and Hook clustering procedure for both tasks and skills/abilities. (Author/NB)

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Robustness of Job Classification Systems: An Examination of Alternative Indicators

E. Alan Hartman
College of Business Administration
University of Wisconsin Oshkosh
Oshkosh, WI 54901
(414) 424-1424

Michael D. Mumford
Georgia Institute of Technology

In Collaboration with
Steven W. Mueller
Jeffrey R. Cornwall
Dale M. Feinauer
University of Wisconsin Oshkosh

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Abstract

Based on prior research it has been concluded that different kinds of job descriptors yield different job classifications. The limited robustness of such classification systems observed in previous efforts might be attributed to the use of only a few, relatively homogeneous jobs. To examine this hypotheses, both task and ability requirements data were used to describe some 600 positions in occupational fields ranging from clerk to computer programmer. Separate occupational classifications were developed for each type of indicator using a Ward and Hook (1963) procedure. In cross-validation, it was found that the two indicator types yielded very similar occupational classifications.

Robustness of Job Classification Systems: An Examination of Alternative Indicators

Research efforts in industrial psychology are concerned with the activities performed by an individual as the occupant of a certain position in the general division of labor (Fleishman & Mumford, 1986). Of course, members of the work force fill, and to some extent create, an enormous number of unique positions. Unfortunately, an attempt to describe each position and the activities contained in it would yield a confusing mass of information having little value in gaining an understanding of work behavior. Thus, to provide a more parsimonious and systematic basis for its research efforts, industrial psychology has generated methods for classifying positions into a smaller number of jobs or job families (Pearlman, 1980). Because these job classification systems provide the lens and structure through which we understand work behavior, the effectiveness of these descriptive systems has become one of the field's perennial concerns (Harvey, 1986).

The literature does not provide compelling support for the external validity of job classification systems. In his review of the job classification literature, Pearlman (1980) reached the conclusion that different types of job analysis measures yielded different occupational classifications. The strongest empirical support for this conclusion came from a study by Cornelius,

Carron and Collins (1979). Here task, worker oriented behavioral descriptions, and ability requirements data were obtained for seven different foremen's jobs in a process production operation. A Ward and Hook (1963) clustering procedure was applied to each set of descriptors resulting in clusters with marked differences in content.

A careful examination of the Cornelius, Carron and Collins (1979) investigation indicates two alternative explanations for these differences. First, the distance metric used to describe the similarity of foreman's jobs was not held constant across the three data types, and this might lead to spurious differences in the derivative clustering solutions (Gregson, 1975; Hamer & Cunningham, 1979). Second, because this investigation examined only seven jobs, all of which were likely to display substantial similarity by virtue of common position requirements for first line supervisors (Dowell & Wexley, 1979; Prien, 1963), it is possible that there was not sufficient true variation within this sample to permit derivation of stable and general job families. Thus, random error might account for the observed differences just as well as any inherent instability in the occupational families derived from different data types.

The potential existence of artifacts in the Cornelius, Carron and Collins (1979) study indicates that there is a need for further studies at these levels. Thus, the intent of the present investigation is to examine the robustness and external

validity of a set of job families obtained from worker activity and ability requirements data using a sizable sample of positions lying in different occupational fields.

Method

Positions

All student assistant positions within a Midwest University (enrollment of 11,000) were studied. Information from position descriptions and interviews with supervisors and students indicated a great diversity in job requirements across the 1213 positions. These positions included clerical assistants (some of whom ran errands, collated papers, answered the telephone while others essentially coordinated all office functions), sports referees, computer programmers, supervisors of other student assistants, and research assistants. There were 235 supervisors from 87 departments supervising 1213 students.

Instrument

Initial survey development included interviews with 15 randomly selected student supervisors. Based on interviews with supervisors and reviews of a random sample of job descriptions a job analysis questionnaire was developed. Development of the questionnaire included a review of job analysis instruments (i.e. General Work Inventory by Cunningham, Boese, Neeb, & Pass, 1983; and Krzystofiak, Newman, & Anderson, 1979). Items were based on job descriptions on file, interviews with supervisors, and modifications of items from published instruments.

Job Classification

From job descriptions and interviews 10 types of work dimensions were identified. These included oral communication, written communication, supervision of other student assistants, tutoring or instructing others, assisting in research, computer operation (including specific software operation), software development, general clerical activities, artistic (e.g. painting, modeling), and technical activities (e.g. electrical wiring, plumbing).

Ability: For each work dimension a single question assessed the amount of skill or ability was needed to perform the job. The supervisors responded on a 6 point scale ranging from "no skill" to "extreme skill" required.

Task: In contrast to ability items there were several task items for each of the 10 activity dimensions. Table 1 lists the number of items within each of the task dimensions. For each task item supervisors were asked to indicate how much it was a part of the job. The scale ranged from "0" for not part of job to "6" for extremely large part of job. An example of a task item is "Leading group discussion or meetings - for example: questioning group members to clear up points made or summing up results to the group".

The final instrument contained 164 items of which 122 were task oriented items. Table 1 displays the 10 categories with number of task items in each, Cronbach Alpha for the task categories, and descriptive statistics for both task and skill

variables. Based on the high alpha coefficients the task items were summed and this sum was then divided by the number of items in the category. This put task and skill/ability items on a common scale.

Procedure

Supervisors were asked to complete one response sheet for each unique student position supervised. Of the 235 supervisors surveyed, 79 (34%) returned usable completed questionnaires for 152 different jobs. These jobs represented 579 positions (48% of the population) and 42 departments (48%).

Results

To assess the generalizability of clustering results a cross validation sample of 52 was randomly chosen from the sample of 152. The remaining 100 positions formed the model development sample.

To determine the grouping of positions for tasks and skills/abilities, Ward's minimum variance procedure was employed on the model sample. The slope of the error variance to the number of clusters was plotted. For task it seven groups was the point at which reducing the number of groups drastically increased the error variance. For skills/abilities a grouping of seven or nine could be chosen. To be consistent with the task variables seven groups for skills/abilities was chosen.

To confirm the grouping the Ward clustering analysis was performed on the full sample (n=152). The graph of error

variance indicated a grouping of seven as optimal. To determine the similarity between the full sample groups and the model groups, the composition of the full sample clusters were compared to the model sample clusters. Table 2 displays the number of positions in each group for model and full samples for both task and skill/abilities groups. The similarity of the two solutions was assessed by identifying how many positions from the model sample appeared in the same group for the full sample. As the table shows the task groups typically had 75% of the model positions appearing in the full sample group. Overall the results are quite positive with 80% of positions based on task clustering and 77% of positions based on skill/ability clustering being consistently placed in both model and full samples.

Table 3 displays the number of positions by group for skill/ability and task data for the model sample. Note that the skill/ability groups have been reordered so that if all positions within a task group are in the same skill/ability group then there will be zeros everywhere except on the diagonal. A chi square goodness of fit test indicated that the groupings were not identical ($x^2(7)=29.34$, $p<.005$). However, a t test comparing the expected percentage on the diagonal to the actual percentage indicates that the two groupings are not independent ($t(99)=9.35$, $p<.005$). It would be expected that 14% of the positions would be on the diagonal yet the percentage is 47%. The results for the

full sample were identical.

The second procedure to identify comparability of clusters generated by the two information domains consisted of discriminant analyses (one analysis using task groups with task variables, one using task groups with skill/ability variables, and skill/ability groups with the two variable sets separately). Table 4 displays the significant discriminant functions for the four analyses. All discriminant analyses produced at least four significant functions (for all subsequent analyses reported the four function solution is utilized). Task and skill/ability variables were not only able to discriminate between task groups but they also were able to discriminant between skill/ability groups.

Based on the discriminant analyses the seven groups could be described in the following manner. There were four clusters which included clerical tasks/skills: a) basic clerical tasks requiring little skill, b) a somewhat higher level skill and greater variety of tasks including running of machines, c) word processing and high level of skill, and d) clerical supervisor. The remaining three groups could be defined as : a) high oral and written communication skills with tutor type tasks, b) lab assistant and discussion leader tasks with communication skills, and c) high computer software and technical skills.

A test of the relative quality of these discriminant functions is how well they discriminate between groups in the

cross-validation sample. Table 5 shows the results for the four discriminant classification analyses for the model sample and the cross-validation sample. A chi-square test assessed the relative accuracy of classification for the two samples. As the table indicates task groupings show no loss in classification accuracy when moving from the model sample to the cross validation sample. In contrast, the skill/ability groupings show a significant decrease in accuracy.

The second test is on the accuracy of the models relative to random assignment of positions to clusters. The chi-square results for model compare the baseline number correct (number in the largest group) to actual correct classification. All of these comparisons are significant with the exception of the skill/ability groups with task variables for the cross-validation sample.

Discussion

The results presented lead to a variety of conclusions concerning the nature and content of job classification systems. Perhaps the most straightforward finding is the validity of job families derived from the Ward and Hook clustering procedure for both tasks and skills/abilities. The clusters were psychologically meaningful, discriminated between positions on both tasks and skills/abilities, and displayed a high accuracy of classification for both model and cross-validation samples.

The clustering results demonstrated both internal and

external validity. The finding of high internal validity is not unique in that other studies have also obtained such results (Zimmerman, Jacobs, & Farr, 1981). What is unique is the external validity demonstrated by the cross validation procedures and the cross content domain differentiation. Eliminating the potential methodological problems identified in the Cornelius, Caron and Carey (1979) study resulted in clear support for the similarity of classification structures produced by task and skill/ability items.

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Table 1

Summary Statistics for Task and Skill Variables

		Tasks			Skills	
Variable	Number of Items	Alpha	Mean	S.D.	Mean	S.D.
Oral	5	.79	1.72	.91	4.22	1.52
Written	5	.77	2.21	1.21	2.16	1.72
Supervision	8	.85	1.85	1.04	1.81	1.49
Instruction	4	.82	1.81	1.19	2.21	1.77
Research	7	.91	1.37	.84	1.50	1.11
Operation	6	.87	1.14	.49	1.38	1.07
Development	15	.97	1.36	.78	1.56	1.31
Clerical	10	.90	1.90	1.16	2.88	1.85
Artistic	5	.62	1.17	.44	1.39	.94
Technical	11	.90	1.31	.65	1.48	1.10

Table 2

Number in Each Group for Model and Combined Samples

Group	Model	New	Number In Common	Percent In Common	From Another Cluster	Missing	Combined
Task Groups							
1	14	7	12	86%	0	2	21
2	2	2	2	100%	1	0	4
3	31	22	25	81%	3	1	49
4	15	12	12	80%	3	3	26
5	7	3	3	43%	3	3	9
6	21	6	16	76%	0	6	28
7	10	5	10	100%	5	0	15
Skill Groups							
1	12	8	12	100%	1	0	20
2	22	11	12	55%	6	5	34
3	8	11	8	100%	13	0	19
4	5	0	0	0	0	0	0
5	18	4	16	88%	0	2	22
6	22	12	16	73%	0	6	34
7	13	3	13	100%	0	2	18

Table 3

Taskby Skill Groups Classification

For Model Sample

Task	1	2	5	6	4	7	3
1	8	5	1	0	0	0	0
2	0	0	0	1	1	0	0
3	0	6	13	12	0	0	0
4	2	3	3	7	0	0	0
5	1	0	1	1	4	0	0
6	0	4	0	0	0	12	5
7	1	4	0	1	0	1	3

Table 4

Discriminant Analysis Results Model Sample

Group	Variables	Function	df	X^2	P<	Wilks
TASK	TASK	1	60	588.48	.000	.0015
		2	45	409.28	.000	.0109
		3	32	257.32	.000	.0582
		4	21	124.88	.000	.2516
		5	12	33.72	.000	.6890
TASK	SKILL	1	60	311.58	.000	.0320
		2	45	177.71	.000	.1403
		3	32	91.74	.000	.3629
		4	21	39.69	.01	.6450
SKILL	SKILL	1	60	665.11	.000	.0001
		2	45	477.66	.000	.0051
		3	32	321.81	.000	.0286
		4	21	209.39	.000	.0989
		5	12	115.77	.000	.2782
		6	5	30.61	.000	.7130
SKILL	TASK	1	60	381.92	.000	.0147
		2	45	214.35	.000	.0936
		3	32	116.52	.000	.2760
		4	21	52.58	.000	.5593

Table 5

Summary of Classification Results from Discriminant Analysis for Initial and Holdout Samples Separately

			Classification		
Group	Varialbes	Sample	Correct	Incorrect	Chi-Square
Task	Task	Initial	88	12	
Task	Task	Holdout	42	10	NS
Skill	Skill	Initial	86	14	
Skill	Skill	Holdout	32	20	11.79*
Task	Skill	Initial	60	40	
Task	Skill	Holdout	27	25	NS
Skill	Task	Initial	61	39	
Skill	Task	Holdout	18	34	9.54*

* $p < .01$

ALL CLASSIFICATION RESULTS EXCEPT THE HOLDOUT SAMPLE FOR SKILL GROUPS AND TASK VARIALBES DIFFER SIGNIFICANTLY ($P < .01$) FROM CHANCE CLASSIFICATION.